August 2000

Proceedings of 2nd Bird Strike Committee USA/Canada Annual Meeting

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8-10 August 2000
Minneapolis, Minnesota USA (www.birdstrike.org)

ABSTRACTS

PLENARY ADDRESS: JET ENGINE CERTIFICATION STANDARDS

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The ability of modern jet engines to ingest birds and continue to operate is largely misunderstood or not contemplated at all in the aviation industry. Currently, there is not one jet engine operating in the world that is certified to ingest one large bird (goose, swan, stork, pelican, vulture, etc) and continue to operate. The effort to harmonize bird ingestion rules between the FAA and JAA has failed. Controversy erupted in recent certification meetings regarding the database being used to certify engines. Additionally, should only rotating engine parts meet certain standards, or all engine parts exposed to impact meet standards? None of the work done by or papers presented to IBSC regarding bird ingestion are used in developing certification standards. Flightcrew members do not know, nor are they required to know, how fragile their engines are. Airport bird control personnel cannot appreciate the importance of their work unless they understand the small number of birds the engines can ingest and continue to operate. The industry needs education on the importance of strike avoidance due to the thin safety margin provided by engine ingestion standards.

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WILDLIFE MANAGEMENT TOOLS – WHAT'S IN YOUR TOOLBOX?

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Airport managers of today are faced with a variety of choices of what tools to use to deal with their wildlife problems. The Airside Operations staff of the Minneapolis-St. Paul International Airport (MSP), has developed a "Wildlife Toolbox" which offers an assortment of programs, systems and devices to best deal with problem wildlife at a large northern tier hub airport. This "toolbox", developed over time, includes not only the basics needed by an Airport Manager, but some rather unique tools that managers should consider when developing their own toolboxes.

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CANADA GOOSE MANAGEMENT AT THE MINNEAPOLIS-ST. PAUL INTERNATIONAL AND DOWNTOWN ST. PAUL AIRPORTS

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The Metropolitan Airports Commission initiated a Canada goose control program at the Minneapolis-St. Paul International Airport (MSP) in 1984, and the Downtown St. Paul Airport (DTSP) in 1994. Flightless geese within 16 km of these airports were trapped, neck-banded, and observed and counted weekly from September to December (MSP) and February (DTSP). Efficacy was measured by observing fall goose flights through the operations airspace in 1984-87, 1998-1999 (MSP) and 1994-1999 (DTSP). A total of 2,587 geese were removed from 36 MSP sites and 2,163 from 12 DTSP sites. From 1990 to 1999, 535 nests containing 2,637 eggs were destroyed and 418 breeding geese shot on 7 MSP wetlands. MSP populations declined significantly ($P<0.01$) from 1989 to 1997, then increased in 1998 and 1999. MSP airspace geese declined ($P<0.01$) from 25 (1984) to 4 birds/hr (1987), then rose to 21 (1998) and 16 (1999). A negative correlation ($P<0.5$) was found between geese within 2 km and airspace flights, thus, flight frequency is strongly influenced by behavior. DTSP populations declined ($P<0.01$) between 1994 (46) and 1995 (23), averaging 24 during 1996-1999. DTSP geese airspace averaged 126 from 1994-1997 and then declined ($P<0.05$) to 40 (1998) and 70 (1999). Like MSP, the geese within 2 km of DTSP peaked in late-November, but many DTSP birds over-wintered in two nearby spring-fed wetlands and fed on grain spills. Clearly the goose population reduction lowered the strike probability.

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LASERS AS NONLETHAL AVIAN REPELLENTS: PRELIMINARY EXPERIMENTS

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Laser technology has recently been demonstrated as a potentially effective avian repellent; however, controlled studies have not been reported. We conducted 2-choice cage tests to quantify the effectiveness of low-power (10–60-mW) 633–650-nm lasers in preventing Brown-headed Cowbirds (Molothrus ater), European Starlings (Sturnus vulgaris), and Rock Doves (Columbia livia) from perching and Canada Geese (Branta canadensis) and Mallards (Anas platyrhynchos) from use of grass plots. In 3 experiments with stationary and moving laser beams "defending" a randomly selected perch, brown-headed cowbirds were not repelled, nor did they exhibit behaviors indicating perception of the beam. Similarly, a moving beam did not repel European Starlings from treated perches. Rock Doves exhibited avoidance behavior only during the first 5 minutes of 6, 80-minute sessions involving a moving beam. Notably, 6 groups of geese (4 birds/group) exhibited marked repellency to a moving beam in 20-minute sessions (n = 23), with a mean 96% of birds repelled from laser-treated plots. Six groups of Mallards (6 birds/group) were also repelled ($\overline{X}$ = 53%) from treated plots during 2, 20-minute sessions, but habituated to the beam after approximately 20 minutes. Roosting Canada geese, American Crows (Corvus brachyrhynchos), several members of the Anatidae, and various wading bird species were dispersed successfully (from up to 457 m) during field trials. We contend that lasers may prove useful as avian repellents, and may be used to increase avian awareness of aircraft. However, further controlled studies are needed to evaluate species-specific responses relative laser power, beam type, wavelength, and light conditions.

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FLIGHT CONTROL AS A GOOSE DETERRENT AT PORTLAND INTERNATIONAL AIRPORT

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Geese pose a threat to aircraft worldwide. The anthraquinone formula "Flight Control" (FC) is marketed as a deterrent to grazing geese, through an ultraviolet and post-ingestional repellency. The Port of Portland conducted a test to address six objectives regarding the effectiveness of Flight Control. A field with heavy goose activity was divided into five transects, two of which had goose activity 65 percent of the 22 days monitored. These two plots were sprayed using a mixture of one-half gallon of FC, five gallons of water, and eight ounces of an agricultural sticker. This was applied at a rate of one-half gallon per acre. Geese were not observed in the treated areas for the first 10 days. After 10 days, geese were present in the treated plots five of the next 11 days, or 21 percent of monitoring events. At the end of six weeks, treated areas had goose activity in 13 percent of monitoring events, compared to 32 percent in untreated areas. We concluded that Flight Control was an effective goose deterrent on turf with total avoidance for the first 10 days. However, geese did not avoid the entire project site, only the treated plots. Geese also did not learn to avoid treated areas and returned to treated plots as soon as the product had decreased in concentration. There were no adverse effects to non-target birds, or to treated grass. Therefore, FC is an effective temporary goose deterrent for specific areas.

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BIRD STRIKE TRENDS AND BIRD HARASSMENT EFFORTS IN CHINA

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China is a large developing country. Under recent policies, the aviation industry has grown quickly. The bird-strike events have also increased rapidly, with 170 bird strikes recorded from 1991 to 1997. The Civil Aviation Administration of China (CAAC) monitored these trends closely, and ABSAC was formed. We imported some products from the USA, which imitated a bird's distress call, but these products didn't work well in China. CAAC entrusted Tsinghua University to solve this problem. SBS company of Tsinghua University, led by Professor Xi Boa Shu took this task. For two years, SBS manufactured a series of products to prevent birdstrikes. Among these, we used powerful acoustic waves to disperse birds, and progress was made.

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DEER MANAGEMENT AT AIRPORTS: A CASE STUDY

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Deer living on and around airports pose a threat to aircraft. The consequence of a deer-aircraft strike can be serious and potentially tragic. Nationally, cervids (deer) accounted for 67% of all reported mammal-aircraft strikes and have caused damage in 81% of deer strikes in the United States (Cleary et al. 1999). Due to the potential for damage, the Federal Aviation Administration and USDA-APHIS-Wildlife Services (WS) program recommend a zero-tolerance of deer on an airfield. Deer densities at Newport News / Williamsburg International Airport (PHF) were as high as 171.5 deer/mi^2 at the onset of the Wildlife Hazard Assessment conducted by WS. Several factors contributed to this extraordinary deer density including: inadequate fencing, abundant high quality food, insufficient hunting pressure on the AOA and a lack of hunting on adjacent properties, and unlimited security cover to provide shelter. Prior to the cooperative agreement between PHF and WS, the deer depredation plan in effect at PHF did little to limit the growth of the deer herd. However, following the
removal of 113 deer by WS through sharpshooting, the deer population at PHF was successfully reduced by 88 percent, subsequently reducing the threat to aviation.

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DEVELOPMENT OF A BIRD AVOIDANCE MODEL FOR NAVAL AIR FACILITY EL CENTRO, CALIFORNIA

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Two weeks after the Elmendorf AFB-AWACS crash (22 September 1995), the US Navy lost an F-18 Hornet to a birdstrike at Naval Air Facility El Centro (NAFEC) in southern California. NAFEC is surrounded by agricultural land where crops are grown year round, and its location just 26-km south of the Salton Sea National Wildlife Refuge suggests a very high probability of additional serious birdstrikes in the future. We are developing a computer-based Bird-Avoidance Model for the airfield and its two associated bombing ranges, to decrease the number of damaging birdstrikes. We are currently conducting bird counts to assess the distribution of birds in the area throughout the year. Additionally, we are analyzing more than 38,000 records in the Air Force birdstrike database and combining those data with our onsite observations to develop an index of the birdstrike hazard at each site throughout the year. Air Force data are also being analyzed to evaluate differences in the vulnerability of each aircraft type to birdstrike damage. Combining aircraft vulnerability with hazards at each site yields the birdstrike risk. The predictions of the Bird-Avoidance Model will be compared with and tested against Navy birdstrike records. After completion, the model will be accessed via the Internet by flight schedulers, aircrew, and others involved in birdstrike-hazard management. The model will be made available to the Navy by June 2001.

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UTILITY OF TDWR AND ASR-9 DATA TO MITIGATE BIRD STRIKES AT COMMERCIAL AIRPORTS

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Conflicts between birds and commercial aircraft are a noteworthy problem at both large and small airports. The risk factor for U.S. airports continues to increase due to the steady rise in take-off/landings and bird populations. The focus of bird strike mitigation in the past has centered primarily on Wildlife Management techniques. Recently, an Avian Hazard Advisory System (AHAS) has been developed to reduce the risks of bird strikes to military operations. This system uses a mosaic of data collected by the Next Generation Weather Radar (NEXRAD). This sensor serves as an excellent tool for enroute bird advisories due to the radar coverage provided across the majority of the U.S. The Federal Aviation Administration (FAA) has deployed a network of Terminal Doppler Weather Radars (TDWR) at major U.S. airports to increase safety and reduce delays. While the primary intent of this system is to detect weather, the operating characteristics allow for the detection of biological echoes as well. In fact, roosting birds are a common component of this radar system during peak activity periods near sunrise and sunset. This sensor provides excellent coverage and update rates within the terminal area for bird detection. Another terminal area detection sensor deployed by the FAA is the Airport Surveillance Radar (ASR-9). While the primary goal of the target channel is aircraft identification, this radar is also able to detect biological echoes near the airport. Proposed enhancements to the ASR-9 will make this sensor more efficient as a weather/bird detection sensor. The high update rate (5 seconds) makes the ASR-9 a highly desirable platform for a bird detection and warning system. In this paper, the bird detection capabilities of the TDWR and ASR-9 target channel will be discussed. Data on bird events from a number of diverse locales will be used to identify a characteristic set of diagnostic variables for roosting birds. The diagnostic variables will serve as the input to a Terminal Avian Hazard Advisory System (TAHAS) based on an interest fusion approach similar to that employed for the Integrated Terminal Weather System (ITWS) gust front detection and microburst prediction algorithms. Data from recent bird strike incidents at ITWS supported airports will serve to refine the diagnostic variables to better detect small numbers of birds during off-peak roosting times. Hopefully, the TAHAS can be operationally evaluated at a major airport such as John F. Kennedy (JFK), which is situated in an area abundant with avian targets. The goal of this research program is two fold i.e., enhance safety and reduce the monetary costs of bird strike impacts to airline operations.

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POTENTIAL USE OF ON-BOARD RADAR FOR BIRD DETECTION AND AVOIDANCE

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An approach to the reduction of military bird strike costs is proposed. Financial return-on-investment would be maximized by focusing on the most expensive bird strikes without requiring new investment in hardware. Most of the dollar cost of military bird strikes results from strikes in the military-unique high-speed/low-altitude flight regime over remote areas. Avoiding these birds motivates a short time from detection of the bird until the pilot avoidance response because single raptors are now causing a large fraction of the losses. Ground-based sensors with communications links to pilots would be expensive because of the geographic extent of the ranges where these strikes occur. Forward-looking sensors already onboard the aircraft, however, have visibility of all the ranges, and don't need off-board communications. Existing onboard radars in particular can detect the most threatening birds and warn the pilot in time to avoid them. The computers in these high-performance radars are programmed to remove birds (along with other "clutter") before they are displayed to the operator. New software, however, can be added to them to focus on detection, rather than rejection, of the birds that are causing most of the losses. No hardware procurement is needed. This specific design is focused on the prevention of the most costly military bird strikes. Its existence suggests the possibility that analogous designs could prevent much of the commercial, corporate, or private aircraft bird strike losses.

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CURRENT STATUS OF THE USAF BIRD AVOIDANCE MODEL (BAM)

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The United States Air Force (USAF) Bird Aircraft Strike Hazard (BASH) Team has been developing versions of a Bird Avoidance Model (BAM) since the early 1980's. In the developmental phases of the first models, it was recognized that avoiding birds on low-level routes and ranges was the only solution to the significant problem of bird strikes to these military operations nationwide. The early versions of BAM were limited in coverage, biological data, and resolution. With the advent of sophisticated Geographic Information System (GIS) technology and advances in computational capability, modern versions of the USAF BAM have become increasingly robust and user friendly. The current version of BAM, released to the USAF in 1999, incorporates data layers from many sources to display risk surfaces at 1km resolution for the entire continental United States for each two-week period of the year and four daily time periods. Data on over 60 bird species considered most hazardous to flight operations, hundreds of environmental variables, infrastructure, and aeronautical charts are incorporated into the model. The user interface is a menu-driven package that allows pilots and schedulers to assess hazards on chosen routes with minimal effort in minutes. More sophisticated analyses are possible for other user groups. Preliminary reports from the user community have indicated savings of several million dollars in USAF aircraft assets in the first year of operation. Demand from the military community outside the continental US and the civil aviation community indicates a necessity for expansion of the BAM to other areas of the world and for continued refinement of data layers. International cooperation in the development of models will be necessary to ensure more global coverage and compatibility of systems between cooperating nations. The USAF has demonstrated its willingness to share its technology and experience to ensure such interoperability between cooperating agencies and nations.

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THE AVIAN HAZARD ADVISORY SYSTEM (AHAS): OPERATIONAL USE OF WEATHER RADAR FOR REDUCING BIRD STRIKE RISK IN NORTH AMERICA

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The Avian Hazard Advisory System (AHAS) was developed to use NEXRAD weather radar data and National Weather Service (NWS) weather data to forecast and monitor bird activity. The system was tested in a pilot study in 1998 and became operational for the eastern 1/3 of the USA in March 2000. Two thousand low level routes, ranges, airspace and military airfields are evaluated every hour. The monitoring of birds in near real time uses algorithms developed by Geo-Marine, Inc to isolate biological targets from weather. Removing the weather returns permits subsequent processing to retrieve information on bird strike risk to be fully automated. Development of additional algorithms to isolate specific classes of biological targets is underway. These new radar datasets are in Geographic Information System (GIS) format and are being used for improving bird strike risk models and for conservation and ecological applications.

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FAA PERSPECTIVE ON FUTURE DIRECTIONS OF RESEARCH AND DEVELOPMENT TO REDUCE THE BIRD STRIKE THREAT

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As bird strike risks keep increasing, the FAA is actively sponsoring research to minimize these risks. Bird strike risk reduction falls under the area of wildlife mitigation research. In this endeavor, FAA Research and Development faces challenges of budgetary and technical nature. From the budgetary standpoint, R&D funds were until recently very limited and the FAA could not carry out a comprehensive program in this area. Although still under funded, the wildlife mitigation R&D allocation has steadily improved and plans can now be made for the future. At the technical level, the areas of research for bird strike risks reductions are very broad and diverse. The FAA must be very careful in its investment for the future. In its wildlife mitigation research plans, the FAA will maintain a balanced program between competing areas of research, plan and undertake a comprehensive and integrated research program, and leverage its research funds by entering partnerships with other agencies, institutions, and nations.

Specifically, the plans are to:

1. Continue to sponsor traditional R&D in wildlife management at airports. These include grass height management studies, use of chemical repellents, various bird dispersion techniques, and land-use strategies,
2. Investigate the development and deployment of real-time detection techniques at airports,
3. Support the development of a National Advisory Bird Strike System to be used in real-time by commercial and general aviation.

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THE RELATIONSHIP BETWEEN BIRD STRIKES AND WEATHER: A DETAILED SPECIES BASED ANALYSIS

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Bird controllers have recognized for many years that the frequency of bird strikes is related in some way to weather conditions. Previous studies have demonstrated a relationship between bird strike frequency and rainfall on certain airfields. This paper takes bird strike data from five major UK airports and relates them to a variety of weather parameters. It then examines the relationships found on a species by species basis and uses differences in the ecology of the birds involved to suggest the mechanisms by which weather may influence bird strike frequency. The data can be used to better target bird control effort in relation to meteorological conditions and may be important in developing bird avoidance models for airports.

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SUMMARY OF BIRD INGESTIONS INTO AIRCRAFT ENGINES: CURRENT INDUSTRY ACTIVITY AND BIRD STRIKE REPORTING

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This presentation will show some of the bird strikes and/or trends to engines in the past few years. The presentation will emphasize the safety aspects associated with aircraft engine bird ingestions and show the current statistics as understood by the engine manufacturers. The presentation will also address industry activity related to the hazard of larger birds. There will also be comments relative to the importance of accurate and complete bird strike reporting now that many agencies are reporting and collecting data.

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FACTORS ASSOCIATED WITH DAMAGING BIRD STRIKES FOR UNITED STATES AIR FORCE AIRCRAFT

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Analysis of strike data is critical to determine the true economic costs of bird strikes, determine the magnitude of safety issues, and develop preventive measures. Analysis of USAF bird-strike data identified trends and indicated suggested relationships among factors contributing to damaging strikes. From FY 1988 through FY 1997, the annual mean was 2,668 bird strikes with peaks evident in fall and spring. Daylight and dusk were hazardous for bird strikes. More bird strikes occurred during airfield operations and when aircraft were operating at low altitudes (and when soaring birds were more numerous). Aircraft speed, phase of flight, taxonomic group, bird mass and aircraft group were the strongest predictors of damaging bird strikes. Bird strike rates were calculated for USAF aircraft. Bomber aircraft had the highest strike rate; these aircraft frequently fly long missions at low altitudes where they are likely to encounter birds. The analyses indicated that factors contributing to USAF bird strikes overlap and interact. The study allows recommendations for improving reporting of bird strikes and data management as well as make recommendations for airfield management. Results will enable USAF to better focus research on preventing bird strikes, and assess the effectiveness of bird management programs.

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FEDERAL MIGRATORY BIRD PERMITS AND AIRPORTS

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Federal regulations provide for issuance of permits to control damage or other "injury" being caused by migratory birds. The U.S. Fish and Wildlife Service works with USDA, APHIS, Wildlife Services and individual airports to minimize the likelihood of bird/aircraft collisions. This presentation explains the rules, regulations, and procedures related to federal migratory bird permits and the Service's commitment to helping provide the tools necessary to help airports create bird-free air space.

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PRELIMINARY RESULTS FROM SATELLITE AND VHF TRACKING OF RELOCATED RED-TAILED HAWKS AT O'HARE INTERNATIONAL AIRPORT

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Wildlife Services' (WS) activities at O'Hare International Airport (ORD), 1997-1999, significantly reduced the annual number of wildlife strikes reported for ORD. The average annual number of reported strikes decreased from 104.2 (1992-1996) to 49 (1997-1999). However, the number of strikes involving red-tailed hawks (RTHA, *Buteo jamaicensis*) and American kestrels (AMKE, *Falco sparverius*) did not change (14.6 per year). On 1 January 1999, the Federal Aviation Administration sponsored a two-year study, in conjunction with the National Wildlife Research Center and WS-Illinois, to evaluate the efficacy of raptor relocation at ORD. All relocated RTHA were to be fitted with both a United States Geological Service band and an alpha-alpha colorband and then released roughly 64 km, in three different headings (south, west, and northwest), from ORD. In June 2000, 12 resident RTHA were fitted with satellite transmitters and an additional 12 fitted with vhf transmitters. These birds were released 240 km southwest of ORD. The return rate of RTHA based on recapture and recovery data is 8.7% (13 March 1996 – 15 March 2000, n=184 with 16 recoveries). The return rate based on resight and recapture of color-banded RTHA is 13.04% (2 December 1999 – 15 March 2000, n=46 with 6 resights). The use of vhf and satellite transmitters will greatly enhance our ability to track relocated raptors, identify post-release status, more accurately determine the return rate, and possibly identify habitat use by that non-returning RTHA to aid in site selection for future relocations.

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RED-TAILED HAWK TRANSLOCATION FOR REDUCING COLLISIONS WITH AIRCRAFT

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Raptor translocation is currently being used by several airports to reduce collisions with aircraft. Changes in red-tailed hawk (*Buteo jamaicensis*) numbers and hawk/aircraft strikes were studied in relation to translocation of raptors at Eppley Airfield in Omaha, Nebraska from March 1999 through March 2000. The effect of distance on translocation success was also studied. Hawks were captured with pole traps, banded, and released approximately 80, 160, and 240 km from the airport. Two bird surveys were conducted at bimonthly intervals from April 1998 through March 1999, after which surveys were conducted at weekly intervals. These surveys provided an index of hawk numbers on the airfield. Strike data were used to determine if the number of hawk/aircraft strikes had declined. Forty-one red-tailed hawks were translocated from the airfield. No banded birds were recaptured or observed on the airfield. The number of red-tailed hawks on the airfield declined following peak capture periods ($\geq$2 hawks per week). There was a 49% decrease in observed hawks in October 1999 through February 2000 relative to the previous year, with the largest decrease in October (82%). Red-tailed hawk numbers remained unchanged in September and March, prior to peak capture periods. No red-tailed hawk strikes were reported and no carcasses were recovered on the airfield from March 1999 to the present. Translocation of red-tailed hawks 80 km or more was effective in reducing the risk of hawk/aircraft strikes. Management efforts must be persistent, however, as the seasonal migration continues to bring new red-tailed hawks into the area.

HIGH RETURN RATES FOR RELOCATED RED-TAILED HAWKS: PRELIMINARY FINDINGS AT PORTLAND INTERNATIONAL AIRPORT

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Pacific Habitat Services, Inc. (PHS), under contract with the Port of Portland (Port), trapped, banded, and relocated red-tailed hawks at the Portland International Airport (PDX) in Portland, Oregon, beginning in October 1999. Although the Port has a program to deal with wildlife hazards to aircraft operations, raptor prey base management and hazing hadn't effectively reduced wildlife hazards. Nineteen birdstrikes occurred in September, 1999. Prior to this season, birdstrikes ranged from 0 to 11 within a one-month period. Thus, immediate action was needed to reduce raptor abundance on the airfield. In fall and winter of 1999, PHS captured and relocated fifteen hawks, primarily red-tailed. Six were adult birds and 9 were hatch-year birds. A minimum of 5 adult and 4 hatch-year hawks returned after relocation. This rate of return is much higher than that reported by Wernaart et al. (1999), who reported a return rate of only 4% with birds moved similar distances at Canadian Airports. A low return rate was also reported by wildlife personnel at Chicago O'Hare Airport. A likely factor in the high initial return rates is the geography of the PDX area. Hawks may navigate using landscape features such as the Columbia River, the Willamette River and the Cascade Mountains. Continued wildlife surveys on the airfield and color banding also suggest that PDX may support a higher population of resident, non-migratory hawks than airports in other locations.

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REDUCING THE PRESENCE OF RAPTORS AT KANSAS CITY INTERNATIONAL AIRPORT

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Nationwide, between 1991 and 1997, the FAA wildlife strike database reported 939 raptor strikes, which accounted for 12% of all reported wildlife strikes. At Kansas City International Airport (MCI), between 1997 and 1999, 9 raptor strikes occurred involving known aircraft and 27 raptor strikes occurred involving unknown aircraft. These raptor strikes represented 13% of all wildlife strike events at MCI. MCI has a large yearly influx of raptors (red-tailed hawks, American kestrels, northern harriers, and great horned owls) during the period of October through March. From October 1997 until December 1999, 40 raptors were removed from the airport through the use of pole traps and bal-chatri traps, and on rare occasions by lethal methods. Because trapping raptors is labor-intensive, a more permanent solution to decrease the raptor food source on the airfield was proposed. A 205-acre test area on the airfield was treated with zinc phosphide in October 1998, which resulted with positive results. Concluded in December 1999, the remaining 1,332 acres of land inside the AOA was treated with zinc phosphide. The goal of the zinc phosphide treatment was to reduce the large rodent population on the AOA, thereby reducing the number of raptors and other predators that prey upon rodents. Airfield wildlife patrols have indicated a significant reduction of raptor and coyote sightings.

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MANAGEMENT OF RODENT POPULATIONS AT AIRPORTS

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Birds and other wildlife are a serious problem at U.S. airports. Certain species are more hazardous to aviation safety than others, most often due to the size and behavior of the species. Raptors, including hawks, vultures, and eagles, were the fourth most common bird group reported in bird strikes to the Federal Aviation Administration from 1991 - 1997, and hawks specifically were the fifth most common bird species group reported in bird strikes in Canada during the same time period. Red-tailed hawks were the fifth most common bird species reported in U.S. Air Force bird strikes from 1985 - 1999, resulting in over $12 million in damage costs. Since raptors are protected under the Migratory Bird Treaty Act, the ability to directly manage raptor populations is limited. Management of their habitat, however, is often more easily accomplished. Raptors are attracted to airport habitats that provide their basic necessities: food, water, and cover. Small mammals, such as mice and voles, are attractive prey for raptors. Reduction of small mammal populations at an airport may decrease raptor populations in the area and therefore, reduce the risk that raptors pose to aircraft. Reduction of small rodent populations can be achieved through a variety of methods, including habitat manipulation and the use of rodenticides. Habitat management can be accomplished through a grass height management regime or through the introduction of an endophyte-infected grass which may support fewer herbivores, both of which are currently being studied. Zinc phosphide, a rodenticide, was tested for efficacy at Kansas City International Airport. This presentation will discuss these options and the implications of the studies.

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SUCCESSFUL ACTIONS FOR AVIAN HAZARD CONTROL IN BRAZIL

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Brazil built one of the world's largest aeronautical infrastructures. The airport net is distributed along its vast territory, which shows a tremendous ecosystem variety. Having a large civilian aircraft fleet and also running second after Venezuela in catalogued bird species, Brazil has had problems related to bird strikes. Although Brazil has few problems with migratory birds, the threat posed by resident birds in some airports represents a significant risk. On the other hand, due to human population growth and poor policies of garbage disposal in the past, nowadays some big airports have in their vicinities open dumps that attract birds. That causes an ever-increasing population growth of a bird species similar to the Black Vulture, the Urubu (Coragyps atratus, wt 2Kg, 4lb), that survives by eating the carrion available in those places. Therefore, we have faced the rising risk of bird strikes around some airfields. The solution of the problem encompasses many institutions and requires a great variety of measures. The paper presents some successful actions that have been undertaken by the SIPAER, the Brazilian aviation safety system, to keep the avian hazard under control in Brazil.

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AN EVALUATION OF TECHNIQUES FOR THE CONTROL OF BIRDS ON LANDFILLS NEAR AIRPORTS

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This paper reports progress on an investigation of a variety of bird deterrent techniques on landfill sites. The objective of the study is to develop and test integrated bird management strategies for use on landfills, both close to airports and elsewhere. The first phase of the study is designed to evaluate individual techniques such as distress calls, pyrotechnics, falcons etc. to determine efficacy, time to habituation and differences in effectiveness for different pest bird species. Once the most promising techniques are identified they will be combined into integrated programs and tested long term on a various landfill sites across the UK.

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ANALYSIS OF THE USE OF RADIO-CONTROLLED MODELS IN BIRD DISPERSAL

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Border Collie Rescue (BCR), in cooperation with the Dover Air Force Base, conducted a series of field trials to test the efficacy of utilizing radio-controlled models ("RCs") (aircraft and boats) in dispersing several species of birds from troublesome locations around the Dover AFB environment. Results of these trials suggest that RCs can be used to effectively harass seagulls, raptors, ducks, and geese from difficult areas, though there are a number of limitations that must be taken into account when determining the value of instituting a harassment program utilizing RCs. Though use of Border Collies in its wildlife management program had eliminated the majority of bird hazards at Dover AFB, a few troublesome areas and species remained, particularly those birds that were located in areas inaccessible to the dog (e.g. large quarries with heavy machinery, soaring raptors). Radio-controlled aircraft were highly effective in dispersing large flocks of loafing seagulls, raptors soaring in thermals and passing through the airfield environment, as well as flocks of ducks and teal feeding and resting on open bodies of water. They were also partially effective at discouraging seagulls and geese from utilizing the airspace over the base and seagulls feeding on earthworms on runways and taxiways, though several environmental and operational variables determined success. Radio-controlled aircraft were entirely ineffective in dispersing Canada geese from open water. Coordinated effort with a radio-controlled boat, however, proved to be an effective means of eliminating the Canada goose presence from large bodies of water.

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WILDLIFE CONTROL AT VANCOUVER INTERNATIONAL AIRPORT: INTRODUCING BORDER COLLIES

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Situated on an island located along a major Pacific Flyway, Vancouver International Airport (YVR) has developed a comprehensive wildlife management program in order to maintain a safe aircraft operating environment. YVR attracts a diverse range of bird species, including: ducks; gulls; herons; geese (Canada and Snow); sparrows; swallows; crows; starlings; owls; hawks; and eagles. The airport's Wildlife Management Program consists of a Habitat Management Program and a Wildlife Control Program which are both based on a database of knowledge the airport continues to build regarding the behaviour patterns of wildlife common to the airport. Operating 24-hours-per-day 365 days of the year, YVR's Wildlife Control Program annually moves close to one million birds from the aircraft operating area. Innovation and adaptability have been critical to the success of YVR's program. On foot, in trucks, or in their Zodiacs YVR's Wildlife Control Officers employ many tools in their trade, including: gas cannons; pyrotechnics (including Ruggieri pistols); live ammunition; night vision goggles; high power lights; sirens; nets and wires; traps; and wailers. In November 1999, YVR introduced two Border Collies to its wildlife control program. The introduction of these dogs was a carefully researched and orchestrated event, as the airport recognized that their success would be based on many key factors. Before any commitments were made to introduce the dogs, the airport conducted climate surveys of its staff, initiated site visits, consulted with local veterinarians and animal care specialists and held numerous discussions with the dog trainer/supplier. The program the airport initiated based on this research included the development of a comprehensive dog handler training and certification program, the establishment of policies and procedures for the care and handling of the dogs, and a detailed communications plan.

CREATING A WILDLIFE PROGRAM

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In Feb 2000 Dover AFB hired a wildlife contractor utilizing a Border Collie as one of the main tools in our BASH program. The introduction of the Border Collie, as a tool in bird abatement was thoroughly researched. Since no other base had any other program like this an initial statement of work had to be written. A climate study was conducted with base personnel, the base veterinarian, legal office and the state department of natural resources on the idea of using a dog to harass wildlife. The major obstacles in creating a program this diverse and using a civilian contractor were, securing funding, writing the contract, security issues and persuading personnel to think out of a box. Consultation with other bases helped immensely in formulating a final statement of work for our needs, and in the process many obstacles were overcome.

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THE USE OF BORDER COLLIES TO DISPERSE BIRDS AT SOUTHWEST FLORIDA INTERNATIONAL AIRPORT

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Similar to many airports throughout the United States and Canada, Southwest Florida International Airport (RSW) has a number of development features attractive to wildlife. Such features include stormwater detention ponds, large expanses of open fields, natural wetland marshes, and mature trees. In order to maintain safe operations and minimize the potential for wildlife-aircraft collisions, RSW has expanded the existing wildlife harassment program to include the use of a border collie. An Ecological Study completed by the United States Department of Agriculture (USDA) in 1997 indicated regular use of the airfield throughout the year by wading birds, waterfowl, and blackbirds. Although the RSW Operations Department regularly harassed wildlife with pyrotechnics, USDA noted that many of these birds, especially large bodied sandhill cranes, had become habituated to the noise makers. In addition, many of the most common birds noted by the USDA study were listed as Endangered, Threatened or Species of Special Concern, and are protected from harm by the Florida Fish and Wildlife Conservation Commission. Therefore, it was necessary to implement a new form of harassment that would be effective at reducing wildlife use of the airfield but would not injure the protected wildlife. A border collie was added to the established harassment program in February 1999. Since the border collie joined the bird harassment program, no sandhill cranes nested during the 1999 & 2000 seasons in the AOA, wading bird use was reduced by 50%, wading bird species richness was reduced, crows and blackbird numbers were reduced, and total bird strikes were reduced. Initial results suggest that the program can be improved with changes in the timing and frequency of border collie use. We also recommend sufficient staffing levels and basic training requirements and qualifications for dog handlers.

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THE USE OF BORDER COLLIES IN DOVER AIR FORCE BASE'S WILDLIFE CONTROL PROGRAM

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On February 1, 2000, Dover Air Force Base became the first Air Force base in the world to employ a Border Collie in its airfield wildlife management program. Initial results from Border Collie Rescue's program at Dover AFB are tremendously encouraging, as a substantial percentage of large birds has been excluded from the airbase and the surrounding farmlands, an overall area encompassing roughly 46 km^2. Total bird numbers were reduced by more than 150,000 birds (99.1%) within a short initial 4-week period. The reduction in bird populations present in the Dover AFB environment was accomplished while the numbers of snow geese in the surrounding area had increased significantly in the same time frame. Figures from bird surveys by the Delaware Department of Natural Resources showed the number of snow geese in Delaware during the same month of February increased by more than 50.5% while the number of snow geese in the wildlife area nearest to the airbase (Bombay Hook) increased by more than 310%. This demonstrates that the birds had simply vacated the area immediately surrounding the airbase but remained in Delaware in increasing numbers. Pilots have noted large numbers of birds congregating just outside the Border Collie-patrolled "zone" and field surveys have verified these observations. All of this was accomplished with one wildlife officer, a single Border Collie, and a vehicle. Though the long-term effect on the migratory populations of birds at Dover AFB remains to be seen, the initial results suggest a highly effective mechanism for Dover AFB to combat its bird strike problem.

USDA-APHIS-WILDLIFE SERVICES' INVOLVEMENT AT AIRPORTS DURING FY 1999 (Poster)

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Birds and other wildlife are a serious problem at U.S. airports. Wildlife strikes cost U.S. civil aviation over $300 million per year, based on data from 1990-1998, and the number of reported bird strikes to civil aircraft has increased over 104% during that same time period. The increase in aircraft striking wildlife is due in part to the significant increase of various wildlife populations during the past 30 years. The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) program provides Federal assistance to airports in addressing wildlife hazards to aircraft. To comply with the Government Performance and Results Act (GPRA), WS measured the percent risk reduction achieved by their airport/human safety protection programs. During FY 1999, WS provided assistance to 363 airports in 47 states and Guam. This work includes both technical and direct management assistance. For FY 1999, direct management assistance was performed by WS at 110 airports while technical assistance was provided at 316 airports. The WS goal for its airport work is to increase passenger safety by reducing the risk of aircraft striking wildlife. To calculate percent risk reduction, the risk of a strike is compared from before to after each direct management project. WS met its GPRA goal for FY 1999. The presentation will discuss how goals were determined and how data were analyzed.

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DISPERSAL OF SOARING RAPTORS USING RADIO-CONTROLLED AIRCRAFT (Poster)

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The purpose of the Radio Control flying program is to aid in the effort of bird harassment. Because no one method can be successful in deterring birds from inhabiting the runway area, several different measures must be taken to ensure we are doing all we can to keep them away. Radio-controlled planes, combined with other techniques, are a valuable tool in the ongoing efforts against birds on the airfield. Radio-controlled (RC) planes can scare birds where other techniques fall short. With a range of over one mile, the RC planes can cover most of the runway/infield area while being controlled by one person from one single spot on the airfield. This gives the operator the flexibility to employ bird harassment from basically anywhere at any time. Given this flexibility, the user can effectively harass birds, regardless of bird location or movement. The planes are a 6 foot wing span, balsa wood constructed model powered by a .75 cubic inch gas engine. They travel at speeds of 75-100 MPH and weigh about 5 pounds. When these planes get close to soaring raptors, the birds become scared and fly away. Bottom line: This is a win/win scenario because the birds are not harmed, and the danger to flying safety is mitigated.

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RESOLVING BIRD/AIRCRAFT HAZARDS AT NAVAL AIR STATION NORTH ISLAND, SAN DIEGO, CALIFORNIA (Poster)

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Birds present a direct hazard to aviation safety at Naval Air Station North Island, San Diego, California. We monitored the bird hazards at NASNI between April 1996 and April 1997, made recommendations to resolve the bird hazard to aircraft and evaluated WS Operational program at NASNI. We documented 27 bird/aircraft strikes on NASNI from April 1991 to April 1997. Of these, western gulls represented 77%, mallards 9%, American coots 4.5% and great blue herons 4.5%. Most strikes that occurred between March and September were attributed to western gulls, where as waterfowl were struck most often between October and February. The command Navy Safety Center in Norfolk, Virginia reported 102 bird strikes to aircraft at NASNI between 1980-1996. We observed 33 species of birds on the airfield, with the greatest activity occurring during May. During May, an average of 1,600 birds, mostly western gulls used the airfield daily. The peak period of bird runway crossings occurred in May and August, averaging 120 birds daily. Of 650 gulls colored marked on NASNI with blue tags, only 23 were observed at any one time on the Station. Only 2 of 12 radioed western gulls consistently used NASNI. The greatest distance gulls dispersed from NASNI was 800 km. Following the monitoring program, WS Operations used various control tools to reduce the bird/aircraft hazard at NASNI. The number of birds using the airfield was reduced by 90% and the number of aircraft strikes was reduced by 92%.

MANAGEMENT OF SILVER GULLS TO PREVENT BIRD STRIKES AT SYDNEY AIRPORT (Poster)

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A bird strike is defined as a collision between a bird and an aircraft. While most bird strikes cause little or no damage to the aircraft, some incidents can be fatal and at the least, very costly. The majority of bird strikes occur during landing or take-off thus the focus of bird management is centered around the airport environments. The geographical features surrounding Sydney Airport include a number of bird-attracting water bodies: Botany Bay, Botany Wetlands, the Cooks River and Alexandra Canal. These features attract a diverse and abundant assemblage of migratory and coastal bird species including silver gulls (*Larus novaehollandiae*). Gulls are one of the most commonly struck species worldwide and at Sydney Airport silver gulls account for 43% of all bird strikes. This poster presents information on the spatial and temporal movements of gulls in and around Sydney. It also outlines how the combination of a number of different management techniques have been designed to prevent bird strikes with this species and ultimately to improve air safety at Sydney Airport.

A BETTER WAY TO RECORD AND REPORT ON WILDLIFE MOVEMENTS (Poster)

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As a former Controller, I've recognized that Wildlife Officers usually end up producing hand-counted reports that often fail to highlight critical data such as species trends, primary attractants, dispersant ratios, migration timings, etc. I have written a software program that specifically addresses this problem. AIRMAN (Animal Interdiction Report Manager) is a complete stand-alone program that reports on all aspects of wildlife intervention. There are no calculations to be made, nor any wading through a myriad of daily logs for answers. CYYZ have seen the advantage and have implemented this software already. It produces Line Graphics to display trends based on the species or groups etc. It utilizes pie charts and bar graphs to produce Monthly Killed, Monthly Strike, Annual and Daily Reports to name a few, as well as a Statistical Analysis Report that displays and totals along with data comparisons such as "Bird to Plane" and "Birdstrike to Plane" ratios. AIRMAN provides a powerful Drill-Down Query engine that lets you focus in on a specific problem. It also manages aviary stocks and wildlife tagged or kept for Rehabilitation. In summary, any wildlife encountered and it's surrounding variables, equipment and methods used on that wildlife is recorded and can be immediately recalled for analysis.

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USE OF RADAR SYSTEMS AT COMMERCIAL AIRPORTS FOR BIRD STRIKE HAZARD IDENTIFICATION (Poster)

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Radars have commonly been used for bird detection since the late 1940s. More sophisticated methodologies have been developed over the past 15 years in an effort to provide advisories to pilots flying high-speed, low-level operations. More recently, radars have been used to identify and track bird movements around airports and bombing ranges to develop risk models for bird avoidance. We investigated various radar systems for detecting potentially hazardous bird movements on and in the vicinity of New Orleans International Airport. The systems were used to determine their potential in providing information for development of management strategies, active bird control efforts, community planning, and in-flight advisories. Systems evaluated include: Terminal Doppler Weather Radar, Airport Surveillance Radar, NEXRAD, mobile S-band, and tactical personnel radar. The Terminal Doppler Weather Radar (TDWR) is a 5 cm wavelength (C-band) pulsed Doppler radar that was developed as part of the Integrated Terminal Weather System (ITWS). The main purpose of this system is to identify gust fronts and weather conditions likely to generate wind shear. TDWR systems are located at selected commercial airports that have had a history of turbulent weather. TDWR radar monitors are located in the tower cab and often show large bird movements around the airport. The Airport Surveillance Radars (ASR) are used by air traffic controllers for monitoring approaching and departing aircraft. The ASR-9 is a 10 cm (S-band), fan-beam radar commonly found on commercial airports. Theseunits may also depict bird movements in the vicinity of the airport when the gain is set high. The Next Generation Weather Radar (WSR 88-D) was jointly developed by the FAA, the National Weather Service, and the Department of Defense to provide nationwide weather information. NEXRAD is a 10 cm pulsed Doppler radar that has an effective bird detection range of approximately 64 nautical miles. The uses and limitations of these systems for bird detection on commercial airports will be examined. Additionally the use of specialized bird detection radar and mobile radar systems will be discussed.

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DEFINING AND REDUCING WILDLIFE HAZARDS TO AVIATION IN THE USA (Poster)

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The U.S. Department of Agriculture's National Wildlife Research Center (NWRC), through an interagency agreement with the U.S. Federal Aviation Administration (FAA), conducts a national research program to define and reduce bird and other wildlife hazards to aircraft. The goal is to provide the FAA and airports nationwide with a scientific foundation for policies and recommendations related to wildlife and aviation safety. Research tasks conducted by NWRC under the agreement include: 1) investigations of habitat management and land-use practices on and near airports to reduce bird activity; 2) development and evaluation of bird repellent and frightening methods for airports; 3) management and analysis of the National Wildlife Strike Database for civil aviation; and 4) development of publications, including a manual on wildlife hazard management, for use by airport operators nationwide. The research, coordinated by NWRC's Sandusky, Ohio Field Station, has resulted in over 100 scientific publications since 1992. Recent highlights include 1) development of a wildlife strike database for civil aviation with about 28,000 strike reports, 1990-1999; 2) publication of a report, based on analyses of data in the bird strike database, which indicated wildlife collisions with aircraft cost U.S. civil aviation over $300 million/year, 1990-1998; 3) partnership with private industry to develop chemical repellents for use against Canada geese on airports; 4) development of management program at JFK International Airport, New York, that resulted in a 90% reduction in gull-aircraft collisions; and 5) publication of a comprehensive manual for airport personnel entitled "Wildlife Hazard Management at Airports".

COULD FALCON EFFIGY KITES INCREASE THE EFFICACY OF FALCONRY I.P.M.? (Poster)

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When falconry is employed at airfields, not all birds can be induced to leave. Most do, but some do not go far, then return soon after the patrolling falconer drives away. There is evidence that falcon silhouettes cause fear responses in passerines, some corvids and waterfowl. Dr. Conrad Lorenz towed a silhouette of a goose over young fowl with little response. When the same silhouette was towed in a reverse direction, these same chicks exhibited fear response. Falcon decals are placed on windowpanes to prevent wild birds from colliding into them. Dr. Jeffrey R. Jenkins D.V.M. indicated that since the decals were installed that bird collisions with his office windows had ceased. Hunters use huge plastic goose decoys to attract wild geese. These decoys are so large that they also are blinds for two hunters. The large size of the decoys have on most occasions been found to attract more geese than the standard "spread" of life size goose decoys. The converse could be true also. A large falcon silhouette/kite could be flown towed behind the falconers vehicle in between live falcon flights. Because of the large size and increased visibility of the bird scaring kite, it need not be towed at such a height that it would become a navigational hazard to aircraft. Twenty five feet may be high enough. There is currently a bird scaring kite/helium balloon on the market employed in agriculture. There may be a way to employ these kites at airfields.

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BIRD STRIKE REMAINS IDENTIFIED AT NO COST TO AIRCRAFT OWNERS OR AIRPORTS (Poster)

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The U.S. Department of Agriculture's National Wildlife Research Center, through an Interagency Agreement with the Federal Aviation Administration (FAA), maintains a national database of reports of bird and other wildlife collisions (strikes) with civil aircraft. Wildlife strikes are an increasing problem that costs civil aviation in the USA over $350 million annually and the occasional loss of human lives. The database, with about 28,000 strike reports for 1990-1999, provides critical information to airport operators, biologists, engine manufacturers, aeronautical engineers and regulators in designing programs, policies, and aircraft to reduce damaging wildlife strikes. A major deficiency in the database, however, is that about 50% of the reported bird strikes provide no information on the bird species involved. To improve the identification of bird species involved in civil aircraft strikes, the National Wildlife Research Center has entered into an agreement with the Smithsonian Institution, Division of Birds. Dr. Carla Dove, Marcy Heacker-Skeans and their colleagues, at no cost to the airport or aircraft owner, will identify bird remains that are sent with the strike report (FAA Form 5200-7). Remains should be sent in a resealable plastic storage bag attached to Form 5200-7 to the address on the form (FAA Office of Airport Safety and Standards, AAS-310, 800 Independence Ave. SW, Washington, DC 20591). Send whole feathers when possible because diagnostic characteristics are often found in the fluffy part or barbs of the feather base. Beaks, feet, bones and talons also are useful diagnostic material. Pilots, aircraft maintenance and airport operations personnel, and others working on airports can greatly improve the utility of the National Wildlife Strike Database for Civil Aviation by having bird remains identified for strikes where there is uncertainty as to the species involved. The FAA Form 5200-7 for reporting bird strikes can be downloaded from *http://www.faa.gov.arp/birdstrike*. Additional information on bird strike reporting and wildlife hazard reduction at airports is available at *www.birdstrike.org*.